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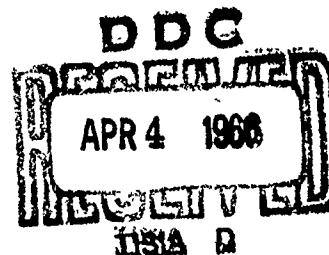
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## U.S. Army Infantry Human Research Unit Fort Benning, Georgia

*Under the Technical Supervision of*

The George Washington University  
**HUMAN RESOURCES RESEARCH OFFICE**  
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RESEARCH MEMORANDUM

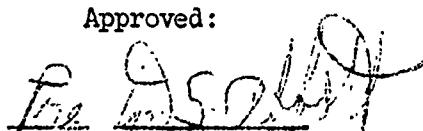
TRAINFIRE V:  
EXTENSION OF RESEARCH ON TRAINFIRE I RIFLE  
MARKSMANSHIP COURSE  
(Subsequent to Technical Report 22, October 1955)

By

Staff, U. S. Army Infantry Human Research Unit

November 1959

Approved:



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Number 18

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#### COMPOSITION OF THE RESEARCH TEAM

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Francis E. Jones was Director of Research and Lt Col Edgar S. Sanders was Chief at the Infantry Human Research Unit while this study was being conducted.

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## FOREWORD

The purpose of Subtask TRAINFIRE V was to produce an improved version of the individual basic rifle marksmanship course developed in Subtask TRAINFIRE I and reported in HumRRO Technical Report 22. The specific objective was to determine the performance increment which would result from increasing the amount of training in separate areas of the TRAINFIRE I marksmanship course.

The training program used in the TRAINFIRE V study consisted of the experimental training tested in the initial administration of the TRAINFIRE I course by the Infantry Human Research Unit during the fall of 1954, as revised in the re-run of the TRAINFIRE I course during the fall of 1955 to provide trained subjects for later aspects of TRAINFIRE research. This revised course reflected the results of experience on the first administration, and of pilot studies conducted during the interval on specific problems.

A Troop Test of the initial TRAINFIRE I marksmanship course was conducted by the Army during the summer of 1955. For the form of the training program adopted by the Army, see Field Manual 23-71, Rifle Marksmanship Course TRAINFIRE I, Department of the Army, September 1957. Results of the TRAINFIRE V study, reported in this Memorandum, are reflected in the course presented in the Field Manual.

TRAINFIRE V:  
EXTENSION OF RESEARCH ON TRAINFIRE I RIFLE  
MARKSMANSHIP COURSE  
(Subsequent to Technical Report 22, October 1955)

BACKGROUND

The mission of Task TRAINFIRE was to develop training methods and proficiency tests to improve the effectiveness of combat rifle marksmanship. TRAINFIRE I, individual basic marksmanship, was reported in HumRRO Technical Report 22.<sup>1</sup> Briefly, the training program consisted of (1) having the trainee fire early in training, (2) combining preliminary rifle instruction with training on the 1000-inch range, (3) employing the 1000-inch range to teach accuracy and other marksmanship techniques, (4) emphasizing target detection training, and (5) firing at ground level silhouette pop-up targets from both supported (foxhole firing) and unsupported (firer's choice of position which provides no external support) ground level positions. At the completion of the TRAINFIRE I experimental training, the group trained by the TRAINFIRE method scored significantly higher on combat-oriented proficiency tests than did the conventionally trained group.

The objective of TRAINFIRE V was to determine the content of a marksmanship course for an improved version of TRAINFIRE I. Specifically, the research problem was to determine the performance increment resulting from increasing the training in separate areas of the marksmanship course.

VARIABLES INVESTIGATED

Increased training was given in four areas to determine the effect on proficiency test performance. The training modifications are summarized in Table 1. The areas are:

1. Preliminary Rifle Instruction (including 1000-inch firing)

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<sup>1</sup> McFann, Howard H., Hammes, John A., and Taylor, John E. TRAINFIRE I: A New Course in Basic Rifle Marksmanship. Technical Report 22, Human Research Unit Number 3 (now United States Army Infantry Human Research Unit), USCONARC, Fort Benning, Georgia, Human Resources Research Office, The George Washington University, Washington, D. C., October 1955.

Table 1

Training Area	TRAINFIRE I Training		Extra Training	
	Hours	Rounds	Hours	Rounds
Preliminary Rifle Instruction	28	102	8	33
Field Firing	36	285	8	96
Target Detection	16	NA	8	NA
Proficiency Tests				
Administration #1	4	56		
Administration #2 <sup>a</sup>			4	56
Administration #2 and #3 <sup>b</sup>			8	112

<sup>a</sup> One additional firing after a two-day interval.  
<sup>b</sup> Two additional firings, separated by a two-day and a four-day interval.

TRAINFIRE I training<sup>1</sup> devoted 28 hours and 102 rounds of ammunition to PRI training. During this training the trainee must attain acceptable accuracy as evidenced by a shot group of three or more rounds. Grouping proficiency was required in each of the firing positions. Since proficiency in the earlier stages of PRI was required before the trainee progressed to more advanced training, it was decided to repeat the final eight hours of PRI in the new study. This was an increase in this phase of 8 hours of training and 33 rounds of ammunition, constituting an increase of 29 per cent in time and 32 per cent in ammunition.

## 2. Field Firing

TRAINFIRE I training devoted 36 hours and 285 rounds to field firing. During this training individual accuracy is required under increasingly complex conditions involving variables of distance, wind, light, weather, and, in the final stages, time pressure and forward movement of the firer. Eight additional hours and 96 additional rounds were allotted to determine the effect on proficiency of increasing instruction in this area; this was a 22 per cent increase in time and 34 per cent increase in ammunition. The additional firing was largely at the longer range, 300 yards, which is an advanced portion of the training given in field firing.

## 3. Target Detection

TRAINFIRE I training devoted 16 hours to target detection training.<sup>3</sup> The addition of eight hours in the new

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<sup>1</sup> The version of the TRAINFIRE I program used in this study was first used in the fall of 1955 to train subjects for subsequent TRAINFIRE unit research. It is a modified version of the training program reported in Technical Report 22.

<sup>2</sup> Field firing is conducted on cleared, level terrain at silhouette targets representing either prone or kneeling ground-level positions.

<sup>3</sup> Target detection training is given to half of the training unit while the other half is firing.

experimental course was a 50 per cent increase in target detection training, to determine whether the increased emphasis thus placed upon target detection would result in greater proficiency in the ability to detect the Marksmanship Proficiency Test targets.

#### 4. Proficiency Test Repetitions

The TRAINFIRE proficiency test involves separate tests of Marksmanship and Target Detection which are considered to be of training value. The trainee must apply all preceding training under conditions more difficult than those previously encountered. The only portion of the training not tested by actual firing test is that portion of target detection skill which cannot be included in the firing tests by reason of safety and measurement limitations.

In TRAINFIRE V the tests were administered four times to determine the point in the learning curve at which a "practical" limit on the training value of the tests would be reached. Administrations of the tests were separated by two- or four-day periods to avoid, as much as possible, transient effects resulting from giving the tests in rapid succession. An interval of eight days separated the first and final tests. Time intervals for the successive tests were: between tests one and two, two days; between tests two and three, four days; between tests three and four, two days. The time periods between the successive tests were the same for the Marksmanship and Target Detection Proficiency Tests.

#### METHOD OF STUDY

##### Subjects<sup>1</sup>

Inductees from Fort Jackson, South Carolina, were utilized as subjects in the study. A total of 240 trainees were selected, 20 of whom were potential alternates for losses which might arise during the week between selection of subjects and initiation of experimental training. The trainees were assigned to the eight treatment groups according to a stratified random procedure; that is, to the extent possible, the groups were equated with respect to Race (Caucasian or Negro), Component (RA or US), and General Technical scores. Attrition during training and testing reduced the number of subjects from 220 to 201 who received the four marksmanship tests and slightly less than 200 who received the Target Detection Tests. The loss of subjects also resulted in some change in the composition of the treatment groups.

<sup>1</sup> A more thorough discussion of the method of selecting and assigning trainees to groups, and the compositions of the eight experimental groups is given in Appendix A.

### Training Schedule

Additional training beyond that given in TRAINFIRE I was given to the eight groups as indicated in Table 2. Since the

Table 2

Group	Amount of Training Given			
	Preliminary Rifle Instruction	Field Firing	Target Detection	Proficiency Test
1	*	*	*	EXTRA
2	*	EXTRA	*	EXTRA
3	EXTRA	*	*	EXTRA
4	EXTRA	EXTRA	*	EXTRA
5	*	*	EXTRA	EXTRA
6	*	EXTRA	EXTRA	EXTRA
7	EXTRA	*	EXTRA	EXTRA
8	EXTRA	EXTRA	EXTRA	EXTRA

\* TRAINFIRE I Training.  
EXTRA: TRAINFIRE I training plus additional training as specified in the text.

eight-group variations included all possible combinations of standard and additional training for each of the three areas included in initial training, the interactions of varied amounts of any type of training could be determined from scores on the first administration of the proficiency test. Successive administrations of the proficiency test, the most advanced portion of the TRAINFIRE course, measured its training value.

### TESTS

TRAINFIRE V tests included informal tests of progress conducted throughout training and the formal proficiency test at

the conclusion of training. It was anticipated that the proficiency test would constitute the Army Record Practice Course in the event TRAINFIRE was adopted.<sup>1</sup>

#### Tests During Training

Under the TRAINFIRE I system of training, each trainee is tested almost daily and maintains his own record of progress in addition to that maintained by his unit. The practice of early firing permits the trainee to fire relatively few rounds each day throughout training. Tests of grouping ability are fired on the 1000-inch range on a target suitably reduced in size. The first group of three rounds, fired in the sixth hour of training (second hour on range), affords both trainee and unit initial data as to individual ability. Daily firings thereafter permit measurement of individual progress.

During Period 7 the trainee fires repetitions of all preceding instruction at 1000 inches. Acceptable grouping proficiency is required from each of eight firing positions as a prerequisite to field firing. From the training viewpoint these successive tests of training not only measure progress but also maintain trainee interest and motivation. Equally important, this firing permits early detection of exceptionally unskilled and skilled trainees. Additional instructor attention can then be given to the unskilled, while the skilled group is available as assistant coaches where required.

#### Proficiency Test

This test, described in detail in HumRRO Technical Report 22, is given upon completion of the other areas of training, to measure both firing and target detection skills. The test requires not only proficiency in the training previously completed but also application of these previously learned skills under more difficult conditions. Since the test constituted the criterion upon which the realism of the TRAINFIRE I training was based, it was necessary that it involve use of the same skills required in combat. The limitations imposed by safety and accurate experimental measurement necessitate separate tests of marksmanship and target detection skills. However, that portion of target detection skill involved in detecting a stationary

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<sup>1</sup> In FM 23-71, the Record Firings (on which the quality scores for marksman, expert, and sharpshooter ratings are based) and the Target Detection Tests derive from this proficiency test.

hostile soldier through his minor movement is used in the Marksmanship Test in detecting and marking the location of the pop-up targets as they rise rapidly into position.

For the Marksmanship Test, the men from the various training groups were assigned to test groups at random. Eight lanes were available on the test firing range, so each test group was divided into two orders of eight firers.<sup>1</sup> To eliminate spurious improvement through learning the target locations, each firer rotated over four lanes on each test. One clip was fired on each of the four lanes from the supported position; the firer then returned to his original lane and rotated over three lanes, firing one clip in the unsupported position on each lane. The range was divided in half and each firer was assigned to one set of four lanes for one administration of the test, and to the other set of four lanes for the next administration. Thus, if a trainee fired on lanes one through four (beginning his rotation on any lane) on the first administration, he fired on lanes five through eight on the second. In this way, not only the specific target positions but also the general areas of the targets were varied. The land on which the Marksmanship Proficiency Test was fired was unimproved except for cutting down some trees. As a consequence, it was extremely difficult to detect the pop-up silhouette type targets except by observation of their upward movement.

The Target Detection Test followed the pattern of training but was conducted on different ranges under the same realistic conditions. Testing groups were the same as for the Marksmanship Proficiency Test. In this test the trainee was required to locate single stationary targets, single moving targets which disappeared in cover, and multiple moving targets which disappeared at the end of brief rushes. He was also required to locate the specific area from which single and double sound targets (rifle shots) originated; these targets were not visible. There was further subdivision into a progression of target locations which were increasingly difficult to detect by reason of their position relative to visible ground references.

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<sup>1</sup> Due to attrition during training, some of the testing groups had less than 16 men.

The single stationary Target Detection Test consisted of 12 trials. Each trial included four phases occurring in order from difficult to easy. In Phase 1 targets were motionless and camouflaged. Phase 2 target indications consisted of slow movement, such as raising head and shoulders or moving from side to side. Rapid movement or exposure of shiny helmet liners characterized Phase 3. The series was terminated in Phase 4 with the target firing a blank, which gave the additional cues of sound, flash, and smoke. Individual total scores were weighted according to phase of detection: Phase 1, four points; Phase 2, three points; Phase 3, two points; Phase 4, one point; total possible score, 48 points.

The single and multiple moving target test consisted of three single-target, four double-target, and three triple-target detection trials. Each correct detection was scored one point, so the total possible score was 20 points. The sound localization test consisted of 10 single detection trials and 10 double detection trials, with a total possible score of 30 points.

As in the case of the Marksmanship Test the separate tests of Target Detection were administered four times, although there was a possibility of spurious improvement through learning of target locations. The specific target positions were varied between tests; however, the same general areas were used for all administrations. As the observer acquired knowledge of the general areas in which the target might appear, there was a possibility of faster detection in the later administrations.

#### FINDINGS

The analysis of the data involved a study of the four training variables as each related to the criterion measures of (1) hit scores obtained from the supported and unsupported positions and (2) target detection scores on single visual targets, single and multiple moving visual targets, and auditory targets. Separate analyses for the two firing positions were necessary as significant interactions were obtained between the position of firing and performance on the proficiency test (Tables B-1, B-2, B-3). The results are summarized in Table 3.

Table 3

<u>Training Area</u>	<u>Field Firing</u>		<u>Target Detection</u>		
	<u>Sup-</u> <u>ported</u>	<u>Unsup-</u> <u>ported</u>	<u>Single</u>	<u>Single &amp;</u> <u>Multiple</u>	<u>Sound</u> <u>Localization</u>
Preliminary Rifle Instruction	None	None	None	None	None
Field Firing	None	None	None	None	None
Target Detection	None	None	None	None	None
Proficiency Test Repetitions					
Adm. #2	4%	None	6%	4%	None
Adm. #2 and #3	None	None	21%	8%	None

1. The additional training in preliminary rifle instruction, field firing, and target detection, singly or in various combinations, did not produce significant differences in either marksmanship or target detection scores on the proficiency test. During training preceding this proficiency test, the group which received additional PRI scored significantly higher than the standard group on a 1000-inch firing test (Table B-7). However, this superiority was not reflected in the scores from the proficiency test measures.

2. Additional administrations of the proficiency test produced a significant increase in scores for some of the measures. The mean hit scores and standard deviations for record firing obtained during each of the successive administrations of the Marksmanship Proficiency Test are shown in Table 4.

Table 4

Record Firing Mean Hit Scores and Standard Deviations for Successive Administrations of the Marksmanship Proficiency Test (N=201)							
Administration Number	Supported Position			Unsupported Position			
	M <sup>a</sup>	s	p	M <sup>b</sup>	s	p	
1	18.8	3.9	> .05	12.0	3.3	< .05	
2	19.4	3.9	< .01	12.6	3.1	> .60	
3	20.6	4.1	< .01	12.7	2.9	> .05	
4	19.6	4.5		12.3	3.2		

<sup>a</sup> Total possible score = 32.

<sup>b</sup> Total possible score = 24.

The score obtained on the first administration reflects the effect of training prior to testing, whereas scores on subsequent tests include the effect of additional practice on the previous test. Thus, the scores obtained for the four administrations can be interpreted as follows:

- a. The first administration measured the effects of prior training.
- b. The second measured the effects of prior training, plus the additional practice afforded by the first proficiency test.
- c. The third measured the effects of prior training, plus the additional practice afforded by two administrations of the proficiency test.
- d. The fourth measured the effects of prior training and the additional practice afforded by three administrations of the proficiency test.

With this interpretation given to the scores for each of the administrations, a difference between the scores on the first and second would show the practice effects of the first administration rather than measure the effects of the second.

One additional administration of the Marksmanship Proficiency Test resulted in a four per cent increase in firing scores (in terms of total possible hits) for the supported position, as measured by the third administration. However, another administration did not result in an increase in percentage hits. Fewer hits were obtained (19.6) with two additional administrations than with just one (20.6). The additional administrations of the proficiency test did not result in a significant increase in hit scores for the unsupported firing position.

3. The mean scores and standard deviations on the Target Detection Test are shown in Table 5 for the successive

Table 5

Target Detection Proficiency Test Mean Scores and Standard Deviations for Successive Administrations of the Proficiency Test						
Administration Number	Single Targets (N=182)			Single and Multiple Moving Targets (N=198)		
	M	s	p	M	s	p
1	23.8	5.8	< .01	11.9	2.8	< .01
2	26.1	4.9	< .01	13.0	2.5	< .01
3	28.9	5.6	< .01	13.8	2.4	< .01
4	36.3	4.2		14.6	2.2	

administrations of the proficiency test (excluding data on sound localization). A significant increase in scores was found between each of the successive administrations of the test employing single targets (Table B-4), and single and multiple moving targets (Table B-5). The over-all analysis of variance on sound localization scores showed only chance

differences between scores for the successive administrations (Table B-6). The mean score of all four tests was 17.2 and the standard deviation was 3.2.

#### DISCUSSION

1. The increased TRAINFIRE V training in preliminary rifle instruction, field firing, and target detection produced no measurable effects on proficiency. This suggests the possibility that the training in these areas could be decreased without a significant decrease in proficiency. Investigation of this possibility would require additional experimentation.
2. Repetition of the proficiency test, the most advanced portion of marksmanship training, produced the most efficient use of additional training time in the TRAINFIRE V program. For supported firing, only through the additional practice given by a second administration of the proficiency test did a significant improvement occur. No reliable differences in scores were obtained from the training afforded by the first testing period, which was included in the TRAINFIRE I training. However, a significant increase in firing scores was found from the second to the third administration. The decrease in performance between the third and fourth tests is presumed to have stemmed from decreased motivation, as it seems more probable that increased training would lead to a decrease in motivation to perform the skill rather than to an actual loss of the skill. In either case, the decrease in performance found during the last test would justify the interpretation that better performance is obtained with only one repetition of the Marksmanship Proficiency Test for supported firing.
3. For unsupported firing, the additional training afforded by the first administration of the proficiency test resulted in a significant increase in firing scores. However, subsequent administrations of the proficiency test did not result in differences in firing scores. This suggests that an increased amount of training from repetitions of the proficiency test does not improve performance under conditions of unsupported firing.
4. The lack of agreement in the results for supported and unsupported firing was not expected and no explanation can be offered. However, the results indicate that these two firing conditions differentially affect performance and should be analyzed separately. These findings show that additional training through re-administration of the proficiency test does not improve unsupported firing, but that performance in supported firing may improve through the repetition in proficiency testing.

It is felt that it would be impractical to separate these two firing conditions for training purposes so, in the event that training by means of the proficiency test were increased for the TRAINFIRE program, the increase would apply to both firing conditions. On the basis of the results in this study, it seems probable that the improvement for supported firing would be of enough value to warrant a second administration of the entire TRAINFIRE I Marksmanship Proficiency Test.

5. A progressive improvement in target detection scores, other than detection by sound localization, occurred through all successive administrations of the proficiency test. However, valid measurement of the improvement in target detection ability as a result of test repetitions was impaired by accumulation of general knowledge of the terrain in the test area by the subjects.

6. Target detection of hidden targets through localization of sound cues did not improve with the repetitions of the proficiency tests.

#### CONCLUSIONS

1. Of the variables investigated, repetition of the proficiency tests constitutes the only effective means of improving TRAINFIRE I. Various combinations of increased preliminary rifle instruction (including 1000-inch firing), field firing, and target detection training, within the limits of this study, do not produce a significant increase in the TRAINFIRE proficiency test scores.

2. One additional administration of the firing proficiency test is sufficient to produce a significant improvement in marksmanship scores for the supported firing position but does not affect scores for unsupported firing.

3. Additional administrations of the Target Detection Proficiency Test improve scores on the tests employing single stationary and single and multiple moving targets, but do not improve detection by sound localization.

4. A second administration of the proficiency tests, excluding target detection by sound localization, is the most effective method, of those tested, of obtaining higher proficiency.<sup>1</sup>

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<sup>1</sup> The TRAINFIRE I course, as adopted by the Army, included this modification for the firing test.

5. Since an increase in training in the other three areas of the TRAINFIRE course produced no measurable effect on proficiency, it is possible that the training time in those areas could be decreased without significant loss in proficiency.

**APPENDICES**

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## Appendix A

### APPENDIX A

#### Selection and Assignment of Subjects

The subjects in the study were selected from trainees newly inducted at Fort Jackson, South Carolina, over a four-day period in early March 1956. Of the total input, all qualified trainees were to be selected until a total of 240 were obtained. The only restriction imposed upon the selection by the Infantry Human Research Unit was that conscientious objectors be excluded from the sample. During the four-day period there were none. Restrictions imposed by Fort Jackson authorities for reasons unrelated to the study eliminated personnel in the following categories:

1. Eye refractory cases
2. Individuals comprising a buddy pair (unless both men were assigned)
3. RA commitments unless assigned to Infantry
4. Men assigned to transitional training units on the basis of USAIF test scores
5. Men classified as specialists

The number of trainees available from the total input for each of the selection days was as follows:

<u>Selection Day</u>	<u>Total Input</u>	<u>Number Restricted</u>	<u>Number Available</u>
2 March	146	81	65
5 March	151	62	89
6 March	93	34	59
7 March (AM)	53	20	33
	443	197	246

As indicated, selection of all available trainees on the first three days yielded a total of 213. To reach the goal of 240 required for the study, 27 trainees were selected at random (using a table of random numbers) from the 33 available on the morning of the fourth day.

## Appendix A

Of the total 240 subjects, 20 were designated by means of a table of random numbers to serve as alternates in the event losses occurred between the time of selection and the company's arrival at Fort Benning, a time period of one week. In the order in which the 20 alternates were selected, consecutive numbers were assigned which gave their respective replacement priority. When the men were transferred to Fort Benning, four of the original 220 were unable to accompany the group. The first four alternates were still available and, therefore, replaced them.

The trainees were assigned to the eight treatment groups according to a stratified random procedure; that is, to the extent possible, the groups were equated with respect to Race (Caucasian or Negro), Component (RA or US), and General Technical scores. Since it was impossible to achieve perfect equation in deep stratification, priority for equation was in the order in which the variables are listed above.

Attrition during training and testing reduced the total number of subjects from 220 to 201 who received the four Marksmanship Tests and slightly less than 200 who received the Target Detection Tests. The loss of subjects also resulted in some change in the composition of the treatment groups. The compositions of the groups during the Marksmanship Tests with respect to the stratification variables both prior and subsequent to attrition were as follows:

### a. Before Attrition

Group	N	Mean GT Score	Per Cent by Service Number		Per Cent by Race	
			RA	US	C	N
A	28	88.3	57.1	42.9	60.7	39.3
B	27	89.7	59.3	40.7	59.3	40.7
C	28	86.0	57.1	42.9	60.7	39.3
D	27	88.1	59.3	40.7	59.3	40.7
E	28	88.1	60.7	39.3	60.7	39.3
F	27	88.0	55.6	44.4	63.0	37.0
G	28	86.8	57.1	42.9	60.7	39.3
H	27	87.9	55.6	44.4	63.0	37.0
Total	220	87.8	57.7	42.3	60.9	39.1

Appendix A

b. After Attrition

<u>Group</u>	<u>N</u>	<u>Mean GT Score</u>	<u>Per Cent by Service Number</u>		<u>Per Cent by Race</u>	
			<u>RA</u>	<u>US</u>	<u>C</u>	<u>N</u>
A	26	88.7	53.8	46.2	57.7	42.3
B	25	89.8	64.0	36.0	56.0	44.0
C	26	85.2	57.7	42.3	57.7	42.3
D	24	87.6	58.3	41.7	54.2	45.8
E	26	86.1	61.5	38.5	57.7	42.3
F	25	87.2	56.0	44.0	64.0	36.0
G	28	86.8	57.1	42.9	60.7	39.3
H	21	89.9	52.4	47.6	71.4	28.6
Total	201	87.6	57.7	42.3	59.7	40.3

As indicated above, the average General Technical score for each of the eight groups ranged from 86 to 90 prior to attrition and from 85 to 90 after attrition. The percentage of RA service members in each group ranged from 56 to 61 prior to attrition and from 52 to 64 after attrition. The percentage of Caucasians in each group ranged from 59 to 63 prior to attrition and from 54 to 71 after attrition.

## Appendix B

### APPENDIX B

#### Analyses of TRAINFIRE Proficiency Test Scores

The tables presented are based upon analyses of variance and associated t tests where appropriate.

Tables B-1 through B-3 deal solely with Marksmanship Proficiency Test scores. The original analysis (Table B-1) was for a  $2 \times 2 \times 2 \times 4 \times 2^1$  design with the variables being PRI (A), Field Firing (B), Target Detection (C), Test Repetitions (D), and Positions (E), respectively. Firing position, supported or unsupported, was employed as a factor in the analysis to remove one identifiable source of variance and to determine possible interactions with other variables. The observed interactions (ED and EAC) were treated by carrying out an additional analysis, for each of the firing positions. Each of these analyses (Tables B-2 and B-3) was a  $2 \times 2 \times 2 \times 4$  design for the variables A, B, C, and D, respectively.

Although subjects had been assigned to treatment groups according to a stratified random procedure, the analyses did not take this additional control into account. The multiple correlations between the stratification variables and the criterion measures was too low ( $R = .39$ ) to have any real effect upon the size of error terms. In addition, there were disproportionate N's for calls for the "between" factors. These were too slight to warrant a more complex handling of the data, however, since conclusions would have remained unchanged.<sup>2</sup>

Tables B-4 through B-6 deal solely with the Target Detection Proficiency Tests. There are three general analyses: (1) Single Targets, (2) Single and Multiple Moving Targets, and (3) Sound Localization.

Table B-7 deals with a secondary finding observed within the training program proper. While of some interest, this finding does not directly bear upon the conclusions of this report.

<sup>1</sup> This and all subsequent tests follow Lindquist's treatment for mixed designs. Lindquist, E. F. Design and Analysis of Experiments in Psychology and Education. Boston: Houghton Mifflin Company, 1953 (Ch 13).

<sup>2</sup> Dr. George W. Snedecor, Professor of Statistics at the Iowa State College, served as consultant in these decisions.

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Table B-1

Over-All Analysis of Variance (N = 201)					
Source	SS	df	MS	F Value	p
A (PRI)	3.03	1	3.03	.07	> .20
B (FF)	5.40	1	5.40	.12	> .20
C (ID)	4.17	1	4.17	.09	> .20
AB	18.13	1	18.13	.41	> .20
AC	55.83	1	55.83	1.26	> .20
BC	29.04	1	29.04	.66	> .20
ABC	2.44	1	2.44	.06	> .20
Bet. Resid.	8,556.26	193	44.33	--	--
D (Prof. Test)	292.03	3	97.34	10.71	< .01
DA	36.31	3	12.10	1.33	> .20
DB	12.97	3	4.32	.48	> .20
DC	8.27	3	2.76	.30	> .20
DAB	26.35	3	8.78	.97	> .20
DAC	38.79	3	12.93	1.42	> .20
DBC	8.18	3	2.73	.30	> .20
DABC	21.37	3	7.16	.79	> .20
EA	12.82	1	12.82	1.41	> .20
EB	8.23	1	8.23	.91	> .20
EC	2.65	1	2.65	.29	> .20
ED	76.67	3	25.56	2.81	< .05
EAB	4.84	1	4.84	.53	> .20
EAC	41.18	1	41.18	4.53	< .01
EAD	38.12	3	12.71	1.40	> .20
EBC	17.52	1	17.52	1.93	> .10
EBD	6.04	3	2.01	.22	> .20
ECD	14.25	3	4.75	.52	> .20
EABC	8.48	1	8.48	.93	> .20
EABD	16.29	3	5.43	.60	> .20
EACD	9.87	3	3.29	.36	> .20
EBCD	3.20	3	1.07	.12	> .20
EABCD	5.69	3	1.90	.21	> .20
Within Resid.	12,282.96	1,351	9.09	--	--

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Table B-2

Hit Scores for Supported Firing Position Analysis of Variance (N = 201)					
Source	SS	df	MS	F Value	p
A (PRI)	1.69	1	1.69	.05	> .20
B (FF)	13.48	1	13.48	.37	> .20
C (TD)	.08	1	.08	.00	> .20
AB	21.32	1	21.32	.59	> .20
AC	96.36	1	96.36	2.66	> .10
BC	.73	1	.73	.02	> .20
ABC	3.03	1	3.03	.08	> .20
Bet. Residual	7,004.36	193	36.29	-----	-----
D (Prof. Test)	315.90	3	105.30	9.89	< .01
DA	70.37	3	23.46	2.20	> .05
DB	5.00	3	1.67	.16	> .20
DC	4.52	3	1.51	.14	> .20
DAB	23.96	3	7.99	.75	> .20
DAC	23.76	3	7.92	.74	> .20
DBC	5.74	3	1.91	.18	> .20
DABC	2.66	3	.89	.08	> .20
Within Res.	6,163.59	579	10.65	-----	-----

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Table B-3

Hit Scores for Unsupported Firing Position Analysis of Variance (N = 201)					
Source	SS	df	MS	F Value	p
A (PRI)	14.16	1	14.16	.68	> .20
B (FF)	.15	1	.15	.01	> .20
C (TD)	5.73	1	5.73	.32	> .20
AB	1.66	1	1.66	.08	> .20
AC	.65	1	.65	.03	> .20
BC	45.84	1	45.84	2.21	> .10
ABC	7.88	1	7.88	.38	> .20
Bet. Residual	3,997.86	193	20.71	---	-----
D (Prof. Test)	52.80	3	17.60	2.78	< .05
DA	4.05	3	1.35	.21	> .20
DB	14.01	3	4.67	.74	> .20
DC	18.01	3	6.00	.95	> .20
DAB	18.68	3	6.23	.98	> .20
DAC	24.91	3	8.30	1.31	> .20
DBC	5.63	3	1.88	.30	> .20
DABC	24.50	3	8.17	1.29	> .20
Within Res.	3,673.41	579	6.34	-----	-----

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Table B-4

Single Target Detection Scores Analysis of Variance (4 Tests <sup>a</sup> )					
Source	SS	df	MS	F Value	p
A (PRI)	173.94	1	173.94	3.50	> .05
B (FF)	58.01	1	58.01	1.17	> .20
C (TD)	40.64	1	40.64	.82	> .20
AB	137.04	1	137.04	2.76	> .05
AC	39.75	1	39.75	.80	> .20
BC	11.09	1	11.09	.22	> .20
ABC	25.29	1	25.29	.51	> .20
Bet. Res.	8,640.89	174	49.66	--	---
D (Prof. Test)	16,055.30	3	5,351.77	283.31	< .01
DA	4.40	3	1.47	.08	> .20
DB	22.47	3	7.49	.40	> .20
DC	104.39	3	34.80	1.84	> .10
DAB	20.60	3	6.87	.36	> .20
DAC	26.68	3	8.89	.47	> .20
DBC	33.10	3	11.03	.58	> .20
DABC	9.20	3	3.07	.16	> .20
Within Res.	9,859.36	522	18.89	--	---

<sup>a</sup> N = All trainees (182) who had scores for all four tests.

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Table B-5

Single and Multiple Moving Target Detection Total Scores Analysis of Variance (N = 198)					
Source	SS	df	MS	F Value	p
A (PRI)	6.67	1	6.67	.71	> .20
B (FF)	.40	1	.40	.04	> .20
C (TD)	1.46	1	1.46	.16	> .20
AB	2.23	1	2.23	.24	> .20
AC	6.61	1	6.61	.70	> .20
BC	12.84	1	12.84	1.36	> .20
ABC	1.59	1	1.59	.17	> .20
Bet. Resid.	1,787.51	190	9.41	---	-----
D (Prof. Test)	783.87	3	261.29	50.54	< .01
DA	20.45	3	6.82	1.32	> .20
DB	12.81	3	4.27	.83	> .20
DC	15.76	3	5.25	1.02	> .20
DAB	.72	3	.24	.05	> .20
DAC	5.01	3	1.67	.32	> .20
DBC	6.71	3	2.24	.43	> .20
DABC	6.27	3	2.09	.40	> .20
Within Res.	2,946.40	570	5.17	---	-----

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Table B-6

Target Detection - Sound Localization Total Scores Analysis of Variance (N = 199)					
Source	SS	df	MS	F Value	p
A (PRI)	4.26	1	4.26	.21	> .20
B (FF)	5.50	1	5.50	.27	> .20
C (TD)	22.30	1	22.30	1.09	> .20
AB	12.33	1	12.33	.60	> .20
AC	4.55	1	4.55	.22	> .20
BC	18.21	1	18.21	.89	> .20
ABC	17.84	1	17.84	.87	> .20
Bet. Residual	3,915.48	191	20.50	---	-----
D (Prof. Test)	42.58	3	14.19	2.11	≈ .10
DA	11.80	3	3.93	.58	> .20
DB	12.06	3	4.02	.60	> .20
DC	27.01	3	9.00	1.34	> .20
DAB	17.13	3	5.71	.85	> .20
DAC	6.95	3	2.32	.34	> .20
DBC	7.99	3	2.66	.40	> .20
DABC	4.70	3	1.57	.23	> .20
Within Res.	3,856.28	573	6.73	---	-----

Appendix B

Table B-7

Test in Components of Shooting (Period 7) Mean Hit Scores and Standard Deviations for Standard and Additional Training Groups				
<u>Group</u>	<u>N</u>	<u>M</u>	<u>s</u>	<u>p</u>
Standard PRI (including 1000-inch training)	104	9.7	4.3	< .01
Additional PRI (including 1000-inch training)	103	11.8	4.0	